

## Summary Of The Invention

The present invention is directed to an apparatus and process for dispersing isocyanate-terminated polyurethane prepolymers in water. The apparatus comprises:

- 5 a) at least one reaction vessel containing a water dispersible <sup>isocyanate-</sup>~~isocyanate-~~ terminated polyurethane prepolymer, ~~which is the reaction product of;~~
- 1) at least one polyisocyanate; and
  - 2) at least one polyol and/or polyamine component which ~~may be substituted with at least one hydrophilic moiety;~~
- 10 c) *at least one supply conduit system;* b) at least one supply vessel, ~~containing at least one compound such as water, organic materials and inorganic materials;~~
- d) at least one dynamic mixer, ~~which has a pitched blade turbine within a draft tube, to generate axial flow, configured to provide:~~
- 1) a mixing zone volume greater than about 0.1 liters;
  - 2) an average tip speed greater than about 100 meters/min.;
  - 3) an average power per unit volume input less than about 0.60 watts/cu.cm.;
  - 4) an average residence time of at least about 10-seconds; with
  - 5) ~~an average of at least about 5-passes through the mixing zone; and~~
- 20 wherein the dynamic mixer *[insert (A) from claim 9 (new claim 5)]*
- e) at least one finishing vessel, ~~wherein the dispersion is further reacted to form a water-based polyurethane-urea polymer.~~
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The invention is further characterized by a process for dispersing <sup>isocyanate-</sup>~~isocyanate-~~ terminated polyurethane prepolymers, comprising the steps of:

- a) combining an aqueous solution ~~of organic and inorganic ingredients~~ with at least one water dispersible isocyanate-terminated polyurethane prepolymer to form a materials mixture;
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- b) feeding the materials mixture into <sup>a</sup> at least one axial flow dynamic mixer <sup>to form a dispersion;</sup> and utilizing a dispersing process comprising:
- ~~1) an average tip speed greater than about 100 meters/min.;~~
  - ~~2) an average power per unit volume input less than about 0.60 watts/cu.cm.;~~
  - ~~3) an average residence time of at least about 10-seconds; with~~
  - ~~4) an average of at least about 5-passes through the mixing zone;~~
  - ~~5) an average flow rate greater than about 30 liters/hours;~~
- and <sup>into a</sup> transferring the dispersion <sup>to at least one finishing vessel</sup> and <sup>to</sup> completing the <sup>formation of</sup> isocyanate reaction to form a water-based polyurethane-urea polymer;
- c) <sup>wherein said dynamic mixer limit (A) from claim 9 (new claim 5)</sup>

Surprisingly, the inventive apparatus and process generates uniform prepolymer dispersions using extended residence times and lower energy per unit volume input.

### Brief Description Of The Drawings

Figure 1 is a side fragmentary view, in partial cross-section, of a axial flow dynamic mixer used in the apparatus and process of the invention.

Figure 2 is a schematic diagram of an apparatus of the invention.

### Detailed Description Of The Invention

The present invention is directed to an apparatus and process for dispersing NCO-terminated polyurethane prepolymers. The apparatus is a turbine mixer which has a pitched blade turbine within a draft tube. The turbine mixers, which generate axial flow within the mixing vessel, can be configured to provide a lower energy per unit volume, extended residence times and multiple passes through the mixing zone. Such mixers have proven useful for processing prepolymers which are difficult to disperse in water.

## Claims

1. ~~A~~<sup>A</sup> apparatus for dispersing isocyanate-terminated polyurethane prepolymers comprising:
- at least one reaction vessel containing a water dispersible isocyanate-terminated polyurethane prepolymer;
  - at least one supply vessel;
  - at least one supply conduit system;
  - at least one dynamic mixer which has a pitched blade turbine within a draft tube; and
  - at least one finishing vessel;

wherein the dynamic mixer [insert (B) from claim 9]

2. ~~A~~<sup>A</sup> apparatus according to Claim 1, wherein said water dispersible isocyanate-terminated polyurethane prepolymer is the reaction product of:
- at least one polyisocyanate; and
  - at least one isocyanate reactive component which may be substituted with at least one hydrophilic moiety.
3. ~~A~~<sup>A</sup> water dispersible isocyanate-terminated polyurethane prepolymer as described in Claim 2 wherein said polyisocyanate is selected from the group consisting of aliphatic polyisocyanates, cyclic aliphatic polyisocyanates, aromatic polyisocyanates and mixtures thereof.
4. A polyisocyanate mixture as described in Claim 2, comprising a hindered polyisocyanate.
5. A hindered polyisocyanate as described in Claim 4, including isophorone diisocyanate, tetramethylxylene diisocyanate and mixtures thereof.

6. ~~A~~<sup>A</sup> apparatus as described in Claim 1, wherein said supply vessel contains at least one compound selected from the group consisting of amines, antioxidants, biocides, coalescing aids, coloring agents, defoamers, dispersed pigments, emulsifiable waxes, fillers, fire retardant agents, fungicides, ionic and/or nonionic emulsifiers, natural polymer dispersions, non-polyurethane based emulsifiable synthetic resins, organic co-solvents, perfume-like materials, plasticizers,

sequestering agents, UV stabilizers, water, wetting agents and their mixtures thereof.

3 ~~A~~ <sup>according to</sup> ~~An apparatus as described in Claim 1,~~ <sup>or claim 2</sup> wherein said supply conduit is comprised of pipes.

5 4 ~~A~~ <sup>according to</sup> ~~An apparatus as described in Claim 1,~~ <sup>2</sup> wherein said ~~materials~~ <sup>at least one compound</sup> can be transferred with at least one pump selected from the group consisting of piston pumps, gear pumps, centrifugal pumps, diaphragm pumps, lobe pumps, progressive cavity pumps, peristaltic pumps, screw pumps and vane pumps.

10 5 ~~A process for the preparation of water-based polyurethane-urea polymers with dynamic mixer,~~ <sup>dispensing an isocyanate-terminated polyurethane prepolymer in water</sup> comprising the steps of: <sup>having a pitched blade turbine within a draft tube</sup>

15 a) combining an aqueous solution ~~comprising at least one~~ compound selected from the group consisting of amines, antioxidants, biocides, coalescing aids, coloring agents, defoamers, dispersed pigments, emulsifiable waxes, fillers, fire retardant agents, fungicides, ionic and/or nonionic emulsifiers, natural polymer dispersions, non-polyurethane based emulsifiable synthetic resins, organic co-solvents, perfume-like materials, plasticizers, sequestering agents, UV stabilizers and ~~wetting agents~~ with at least one water dispersible isocyanate-terminated polyurethane prepolymer to form a materials mixture;

20 b) feeding said materials mixture into a dynamic mixer to form a dispersion; <sup>and</sup>

c) transferring said dispersion into a finishing vessel to complete the formation of a water-based polyurethane-urea polymer;

<sup>←</sup> wherein said dynamic mixer ~~have~~ <sup>have</sup> a pitched blade turbine within a draft tube, use a lower energy per unit volume input, have extended residence times and multiple passes through the mixing zone;

A Mixer as described in Claim 1 or Claim 9, wherein said mixer is configured to provide an average tip speed greater than about 100 meters per minute.

25 (A) is configured to provide an average tip speed greater than about 100 meters per minute, an average power of at least per unit volume less than about 0.6 watts per cubic centimeter, an average residence time of at least about 10 seconds with greater than about 5 passes through said mixer and an average flow rate greater than about 30 liters per hour.

11. ~~A mixer as described in Claim 1 or Claim 9, wherein said mixer is configured to provide an average power per unit volume input less than about 0.60 watts per cubic centimeter.~~
12. A mixer as described in Claim 1 or Claim 9, wherein said mixer is configured to provide an average residence time of at least about 10-seconds.
13. A mixer as described in Claim 1 or Claim 9, wherein said mixer is configured to provide greater than about 5-passes through the mixing zone.
14. A mixer as described in Claim 1 or Claim 9, wherein said mixer is configured ~~to provide an average flow rate greater than about 30 liters per hour.~~
15. ~~6~~ <sup>according to claim 5</sup> A process as described in Claim ~~8~~ <sup>5</sup>, wherein said materials are transferred with at least one pump selected from the group consisting of centrifugal pumps, diaphragm pumps, lobe pumps, gear pumps, peristaltic pumps, piston pumps and progressive cavity pumps, screw pumps and vane pumps.
7. A process according to claim 5 or claim 6, wherein the aqueous solution comprises a compound selected from the group consisting of amines, antioxidants, biocides, coalescing ~~and~~ aids, coloring agents, defoamers, dispersed pigments, emulsifiable waxes, fillers, fire retardant agents, fungicides, ionic and/or nonionic emulsifiers, polymer dispersions, organic co-solvents, plasticisers, sequestering agents, U.V. stabilisers, wetting agents and mixtures thereof.